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EP 0421586 A1 EP 0419042 A1 JP 01139678 A
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(54) Two component refrigerant

(57) A refrigerant composition comprises a mixture in non-flammable proportions of pentafluoroethane (R125) with a hydrocarbon selected from propane, propylene, n-butane, isobutane and mixtures thereof. The R125 preferably comprises 60-80 wt%, especially 65-75 wt%, of the composition. The composition is more environmentally acceptable and has reduced ozone-depletion potential.

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TWO COMPONENT REFRIGERANT

The present invention relates to a refrigerant composition for use in refrigeration apparatus which has improved environmental acceptability,and which is capable of being directly substituted for certain current refrigerants without the need to substantially modify existing equipment.

In vapour-compression refrigeration apparatus, three commonly used refrigerants have been the chlorofluorocarbon gases (CFC) referred to as refrigerant 12 (CCl_2F_2), refrigerant 22 ($CHClF_2$) and refrigerant 502 (an azeotrope of R22 and R115 ($CClF_2CF_3$)). However, refrigerants 12 and 115 have been implicated in causing environmental damage. Specifically, these gases, which are very inert, are released from refrigeration systems, aerosols, foam packaging etc. at ground level and diffuse into the upper atmosphere. Because of their inertness, the gases are able to survive without decomposition until they reach the stratosphere where they are broken down by ultraviolet radiation, releasing chlorine atoms which catalyse breakdown of the stratospheric ozone layer. There has recently been considerable concern about reductions in stratospheric ozone levels and this has led to proposed bans on certain CFC'S. Refrigerant 22 is environmentally less objectionable as it tends to be naturally degraded at lower levels of the atmosphere

before reaching the ozone layer. However, the properties of refrigerant 22 are in many respects not as good as, for example, refrigerant 12. Whilst refrigerant 22 is environmentally more acceptable, it has a higher index of compression than refrigerant 12. This means that compressor discharge temperatures become excessive at compression ratios which would not cause excessive discharge temperatures if refrigerant 12 were being used.

Considerable efforts are being made to replace refrigerants 12, 22 and 502 with more environmentally acceptable alternatives. However, such new chemicals are generally unavailable at present and are expected to be considerably more expensive than presently used refrigerants. Also, many requirements must be fulfilled by any successful refrigerant and this severely limits the choice available. Historically, fewer than a dozen refrigerants have seen substantial usage.

It is an object of the present invention to use available compounds in suitable proportions such as to impart the required refrigerant characteristics (such as pressure/temperature relationship, specific heat ratio, latent heat, compressibility, heat transfer properties etc.) to allow direct substitution of current refrigerants, whilst at the same time being of improved environmental acceptability, and at reasonable cost.

Hydrocarbons have been used as refrigerants and as

aerosol propellants. However, the hydrocarbon gases have the serious disadvantage of being flammable.

US Patent 2511 993 discloses use of an azeotropic mixture of refrigerant 22 and propane. However, in the disclosed ratios the mixture would be flammable.

The present invention seeks to mitigate the problems of these gases by utilising a mixture of refrigerant 125 and a hydrocarbon gas in a non-flammable ratio.

Thus, a first aspect of the invention provides a non-flammable refrigerant composition which comprises a mixture in non-flammable proportions of pentafluoroethane (R125) with a hydrocarbon selected from propane, propylene, n-butane, isobutane and mixtures thereof for use as a refrigerant medium in a refrigeration apparatus.

A second aspect provides a method of refrigeration which employs the composition as refrigerant medium.

A third aspect provides a refrigeration apparatus which employs the composition as refrigerant medium.

It is particularly preferred that the R125 and hydrocarbon be present respectively in the composition in the range 60-80 wt.% and 40-20 wt.% respectively, especially 65-75 wt.% and 35-25 wt.%.

As a substitute for refrigerant 22 and refrigerant 502, it is preferred to use mixtures of R125 with propane.

In order to be a successful substitute for the widely

used refrigerant 12 the replacement composition must have broadly similar performance characteristics, so as to enable existing apparatus to continue to be used without modification. One important parameter is the required compressor displacement volume per unit of refrigeration effect produced. Thus, the compressor should be capable of providing about the same degree of refrigeration with the new refrigerant; otherwise a new compressor of different capacity would have to be provided. A mixture of 65-80% (preferably 70-75%) R125 and 20-35% (preferably 25-30%) isobutane is found to give about the same volume displacement per unit of refrigeration effect as refrigerant 12 (viz 5.8 cu.ft/ton refrigeration). Similarly a mixture of 75-90% (preferably 78-86%) R125 and 10-25% (preferably 14-22%) butane also gives about the same refrigeration effect as refrigerant 12.

Refrigerant R125 has relatively poor mixing characteristics with mineral oils normally used for lubrication of the compressor. Expensive specialised oils may be used, but still their miscibility properties are not entirely satisfactory. The inclusion of hydrocarbons significantly alleviates this problem. The compositions also have good motor cooling properties.

On the other hand, the major disadvantage of the hydrocarbons is their flammability. The mixing of these with refrigerant R125 avoids this problem. The composition is non-flammable so that in the event of a

leak of refrigerant medium into the atmosphere, no explosive or flammable mixture is produced. In particular, a non-flammable composition is one which contains the chlorodifluoromethane and hydrocarbon in such a ratio that when the composition is mixed with air in practical proportions (e.g. in the event of a leak) no flammable mixture results.

The refrigerant mixture will generally be a non-azeotropic mixture and will therefore act as a mixture rather than as a single gas. Thus, there is a tendency for the refrigerant R125 which has a lower boiling point to evaporate and condense before the hydrocarbon. However, most domestic appliances employ a capillary tube evaporator rather than an expansion valve, so that preferential boiling is not a significant problem. Apparatus should be filled using refrigerant composition in the liquid phase.

Thus, refrigerant compositions of the present invention can be used to replace presently used refrigerants 12, 22 and 502. Moreover, the refrigerant compositions use gases which are non-toxic and readily available at an economic price.

CLAIMS

1. A non-flammable refrigerant composition which comprises a mixture in non-flammable proportions of pentafluoroethane (R125) with a hydrocarbon selected from propane, propylene, n-butane, isobutane and mixtures thereof for use as a refrigerant medium in a refrigeration apparatus.

2. A composition according to the preceding claim wherein the R125 is present in an amount of 60-80 wt%.

3. A composition according to any preceding claim wherein the R125 is present in an amount of 65-75 wt%.

4. A composition according to any preceding claim wherein the hydrocarbon is n-butane or isobutane.

5. A composition according to any of claims 1 to 3 wherein the hydrocarbon is propane.

6. A vapour-compression refrigeration apparatus which employs the composition of any preceding claim as the refrigerant medium.

7. A method of refrigeration which comprises carrying out a vapour-compression refrigeration cycle employing a refrigerant composition of any of claims 1 to 5.

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